PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION

A Process for Improving the Properties of Iron Alloy Castings

We, William Herbert Hatfield, a British Subject, of Brincliffe House, Osborne Road, Sheffield 11, Yorkshire, and Joseph Fenwick Bridge, of 78, Handsworth Road, Handsworth, Sheffield, Yorkshire, a British Subject, do hereby declare the nature of this invention to be as follows:—

The invention relates to a process for improving the properties of iron alloy castings.

In the Specification accompanying our co-pending Application No. 6669/40 (Serial No. 572,374), we have described a process of improving the ductility and toughness of iron alloy castings which comprises the step of reheating the castings after they have been removed from the mould to a temperature only a little below that at which fusion commences i.e. of the order of 1100 to 1350° C., and preferably between 1200 and 1350° C., without mechanical working of the castings. In the process as more specifically described in Specification No. 6669/40 (Serial No. 572,374), the heat treatment is applied more particularly to alloys or high alloy steels which are mainly austenitic in character, whilst for certain of these alloys special additional or superimposed treatments are also described.

According to the present invention the step of reheating iron alloy castings after they have been removed from the mould to a temperature only a little below that at which fusion commences is applied to low alloy steels such as those used in the manufacture of guns and turbine parts, which are not austenitic in character and which may be given their final properties by annealing, normalising or hardening and tempering after the high temperature treatment. The temperatures employed for the heat treatment are of the order of 1100 to 1350° C. and preferably between 1200 and 1350° C.

The steels to which the present invention may be applied may contain the following:—

Carbon	up to 1.0%
Silicon	,, ,, 2%
Manganese	,, ,, 2%
Nickel	,, ,, 6%
Chromium	,, ,, 6%
Molybdenum	,, ,, 4%
Vanadium	,, ,, 3%
Tungsten	,, ,, 4%

Some examples of the results obtained by the invention when applied to steels within the composition given above are as follows:—

[*Price* 1/-]

Price 75p

EXAMPLE I.

(C. 0.32, Ni. 2.76, Cr. 1.23, Si. 0.15, Mn. .49, Mo. .54, V. 18%)

Pre-Treatment	Hardening and Tempering Treatment	Limit of Proportionality	Yield Point	Maximum Stress	Elongation %	Reduction of Area %	Izod Test ft. lbs.
Without preliminary high temperature	Oil Hardened from 850° C. and tempered 650° C. for 4 hrs., followed by 4 hrs. at 665° C. then air-cooled.	(1) 46.2	53.1	61.2	6.5	13	13, 11, 12
		(2) 46.0	53.6	61.4	6.5	13	20, 10, 12
Heated to 1150° C. for 1 hr. and cooled in furnace	Oil Hardened from 850° C. and tempered 650° C. for 4 hrs., followed by 4 hrs. at 665° C. and then air-cooled.	(1) 48.0	52.9	60.5	11.5	17	15, 14, 16
		(2) 49.9	54.5	60.0	10	17.5	22, 15, 15

The above tests show some improvement in ductility resulting from pre-treatment at 1150° C.

EXAMPLE II.

(C. 0.28, Ni. 2.83, Cr. 0.80, Si. .19, Mn. .60, Mo. .55, V. .23%)

Pre-Treatment	Hardening and Tempering Treatment	Limit of Proportionality	Yield Point	Maximum Stress	Elongation %	Reduction of Area %	Izod Test ft. lbs.
Without Preliminary high temperature treatment.	Oil Hardened from 850° C. and tempered 665° C. for 4 hrs. and air-cooled.	(1) 41.0	48.8	55.6	11.5	23	15, 17, 15
		(2) 34.2	44.5	51.4	6	11	14, 10, 10
Heated 1220/1230° C. for ½ hr. and cooled in furnace.	Oil Hardened from 850° C. and tempered 665° C. for 4 hrs. and air-cooled.	(1) 40.0	47.9	55.9	15	30.5	16, 17,
		(2) 38.4	49.8	57.3	17	35.5	20, 20, 18

The above tests show the further improvement in ductility resulting from pre-treatment at 1220/1230° C. All the above samples were treated in the form of hollow cylindrical castings of a wall thickness of 2½" and were all initially in the as cast condition except for a low temperature treatment at 600° C.

Dated this 12th day of April, 1940.

BOULT, WADE & TENNANT,
111 & 112, Hatton Garden, London.
E.C.1,
Chartered Patent Agents.

COMPLETE SPECIFICATION

A Process for Improving the Properties of Iron Alloy Castings

We, WILLIAM HERBERT HATFIELD, a British Subject, of Brincliffe House, Osborne Road, Sheffield, 11, Yorkshire, and JOSEPH FENWICK BRIDGE, a British Subject, of 78, Handsworth Road, Handsworth, Sheffield, Yorkshire, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The invention relates to a process for improving the properties of iron alloy castings.

In the Specification accompanying our co-pending Application No. 6669/40 (Serial No. 572,374), we have described a process of improving the ductility and toughness of austenitic iron alloy castings containing more than 10% of nickel, chromium and manganese together, which comprises the step of reheating the castings after they have been removed from the mould to a temperature only a little below that at which fusion commences, i.e. 1100 to 1350° C. and preferably between 1200 and 1350° C., without mechanical working of the castings. We have also described a modification which includes the further step of effecting, after the treatment at 1100 to 1350° C., the reheating of the casting to a lower temperature e.g. 500 to 700° C. in order to obtain hardening by precipitation, cooling from the higher temperature being effected by air, water or oil at any desired speed according to the dimensions or type of the article being treated.

According to the present invention the step of reheating iron alloy casting after they have been removed from the mould, and without mechanical working, to a temperature only a little below that at which fusion commences, i.e. 1100 to 1350° C. and preferably between 1200 and 1350° C., is applied to alloy irons such as those used in the manufacture of guns and turbine parts, which are not austenitic in character and which contain not more than 10% of the elements nickel, chromium and manganese together. After the castings have been subjected to the high temperature treatment indicated above, they may be given their final properties by known heat treatment methods such as annealing or hardening and tempering.

The alloys to which the present invention relates may contain—

Manganese up to 2%
Nickel up to 6%
Chromium up to 6%

and may contain the following—

Carbon up to 1.0%
Silicon up to 2%
Molybdenum up to 4%
Vanadium up to 3%
Tungsten up to 4%

the upper limit of the total amount of these additional elements being 10%.

The invention is not concerned with alloys containing other metals such as cobalt, aluminium or titanium.

Some examples of the results obtained by the invention when applied to castings from steels within the composition given above are as follows:—

EXAMPLE I.

(C. 0.32, Ni. 2.76, Cr. 1.23, Si. 0.15, Mn. .49, Mo. .54, V. 0.18%)

Pre-Treatment	Hardening and Tempering Treatment	Limit of Proportionality	Yield Point	Maximum Stress	Elongation %	Reduction of Area %	Izod Test ft. lbs.
Without preliminary high temperature	Oil Hardened from 850° C. and tempered 650° C. for 4 hrs., followed by 4 hrs. at 665° C. then air-cooled.	(1) 46.2	53.1	61.2	6.5	13	13, 11, 12
		(2) 46.0	53.6	61.4	6.5	13	20, 10, 12
Heated to 1150° C. for 1 hr. and cooled in furnace	Oil Hardened from 850° C. and tempered 650° C. for 4 hrs., followed by 4 hrs. at 665° C. and then air-cooled.	(1) 48.0	52.9	60.5	11.5	17	15, 14, 16
		(2) 49.9	54.5	60.0	10	17.5	22, 15, 15

The above tests show some improvement in ductility resulting from pre-treatment at 1150° C.

EXAMPLE II.

(C. 0.28, Ni. 2.83, Cr. 0.80, Si. .19, Mn. .60, Mo. .55, V. 0.23%)

Wthiout Preliminary high temperature treatment.	Oil Hardened from 850° C. and tempered 665° C. for 4 hrs. and air-cooled.	(1) 41.0	48.8	55.6	11.5	23	15, 17, 15
		(2) 34.2	44.5	51.4	6	11	14, 10, 10
Heated 1220/1230° C. for ½ hr. and cooled in furnace.	Oil Hardened from 850° C. and tempered 665° C. for 4 hrs. and air-cooled.	(1) 40.0	47.9	55.9	15	30.5	16, 17,
		(2) 38.4	49.8	57.3	17	35.5	20, 20, 18

The above tests show the further improvement in ductility resulting from pre-treatment at 1220/1230° C.

All the above samples were treated in th form of hollow cylindrical castings of a wall thickness of 2½" and were all initially in the "as cast" condition except for a low temperature treatment at 600° C. This low temperature treatment at 600° C. arises as follows: Some castings when simply cooled right out and taken from the mould may, owing to their composition, be somewhat hard and at the same time may contain internal stresses. In such cases castings are, with as little delay as possible, heat treated at a temperature of 600° C. with the object of rendering them less liable to crack on continued exposure. Treatment of this type should be clearly distinguished from the ordinary annealing treatment which usually involves prolonged heating at higher temperatures. The incidence of this preliminary heat treatment of the casting in no way affects the results of the subsequent heat treatment.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A process of improving the ductility and toughness of a casting from a non-austenitic alloy iron containing not more than 10% of the elements nickel, chromium and manganese together, comprising reheating the casting after it has been removed from the mould, and without mechanical working, to a temperature only a little below that at which fusion commences, i.e. between 1100 and 1350° C. and preferably between 1200 and 1350° C.

2. A process according to claim 1 in which the castings are made from alloy irons containing nickel up to 6%, chromium up to 6% and manganese up to 2%.

3. A process according to claim 1 or claim 2 in which the castings are made from alloy irons which also contain carbon up to 1%, silicon up to 2%, molybdenum up to 4%, vanadium up to 3% and tungsten up to 4%, the upper limit of the total amount of these additional elements being 10%.

4. A process according to any one of the foregoing claims and substantially as described in either of the Examples given herein.

5. Alloy iron castings which have been subjected to a process of heat treatment according to any one of the foregoing claims.

Dated this 16th day of August, 1940.

BOULT, WADE & TENNANT,
111 & 112, Hatton Garden, London,
E.C.1,
Chartered Patent Agents.

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